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Resolution of the etching method of graphene/SiC using FIB

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Modern electronics is aimed at reducing the size of the elements. This improves the performance of integrated circuits. An important aspect is the use of modern materials with improved electrophysical properties. Graphene is a two-dimensional carbon material. New areas of its use are constantly emerging. The prospect of its use in electronics is associated with its high mobility of charge carriers at room temperature, electrical and thermal conductivity, and mechanical strength.

In this study, the method of thermal destruction of silicon carbide in vacuum was used for graphene growth. This method allowed us to obtain graphene films directly on an isolated substrate without additional transfer operations, which contribute to the appearance of additional defects in the graphene films. Semiinsulating silicon carbide 6H-SiC was used as the substrate. Silicon carbide is a promising substrate for micro- and nanoelectronic devices, since it is a material with high thermal conductivity, mechanical strength, and is highly resistant to aggressive environments in a wide temperature range [1]. However, certain difficulties appear when profiling SiC substrates due to its high strength and stability. The use of liquid etchants for silicon carbide requires additional high-temperature heating. Also, with liquid etching, there is a limit on the minimum size of the formed elements.

In this work, in order to eliminate the indicated limitations, the method of focused ion beams was used for etching graphene films on silicon carbide. An important advantage of the method is high accuracy and reproducibility of processing, the possibility of maskless etching of structures, the formation of nanoscale elements [2, 3].

The purpose of this work is to study the resolution of the FIB method in the processing of graphene/silicon carbide. This task is relevant in the formation of elements of nanoelectronics [4-6]. A large influence on the parameters of the local processing area is influenced by the ion beam current. Therefore, in this work, an array of recess in the graphene/SiC structure was formed for different values of the ion beam current.

The AFM method was used to study the local areas of experimental samples after FIB treatment. The dependence of the number of detected areas after exposure to an ion beam on the sample surface on the ion beam current was plotted on the basis of the AFM-images. Detection of the treated areas at small values of the ion beam current was difficult. It is revealed that the decrease in the resolution of the method occurs with an increase in the ion beam current. The use of an ion beam in the range of 10-100 pA is optimal for the formation of nanoscale structures.

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